Cal/Ecotox
Exposure Factors for American Kestrel (Falco sparverius)*

Endpoint Type	Endpoint Value	Error	Range	Units	Sex	Life Stage	Location	Note	Reference
Age at Fledging, Metamorphosis, Weaning			28-30	d	B	Fledgling	Lassen; CA	a	1
Age at Fledging, Metamorphosis, Weaning	28.4		26-32	d	B	Fledgling	Lab	b	2
Age at Fledging, Metamorphosis, Weaning			29-31	d	B	Fledgling	Nevada; Sierra; CA	c	3
Body Fat (total or %)	2.46	0.25 SE	0.8-4.9	g	B	Adult	Lab	d	4
Body Fat (total or %)	8.51	2.00 SE		%	F	Adult	NJ	e	5
Body Fat (total or %)			4-5.3	%	M	Adult	UT	f	6
Body Fat (total or %)	6.01	1.92 SE		%	M	Adult	CO; NJ	g	5
Body Weight - Mean	119.0		86.0-164.8	g	F	Adult	USA	h	7
Body Weight - Mean	120.2	5.3 SE		g	F	Adult	Lab	i	8
Body Weight - Mean	102.5		80.0-143.0	g	M	Adult	USA	j	7
Body Weight - Mean	113.4	2.0 SE		g	M	Adult	Lab	k	8
Body Weight - Mean	119.8	0.9 SE	117.4-123.9	g	F	Both Adult and Juv.	CA	l	9
Body Weight - Mean	110.7	1.1 SE	105.6-112.1	g	M	Both Adult and Juv.	CA	m	9
Body Weight - Mean			10-12	g	B	Hatchling	Nevada; Sierra; CA	n	3
Clutch or Litter Size	4.3		3.5-4.9	eggs/clutch	F	Adult	Lassen; CA	o	1
Clutch or Litter Size	4.59	0.60 SD		eggs/clutch	F	Adult	CA	p	10
Clutch or Litter Size	5.1		4.8-5.2	eggs per nest	F	Adult	MO	q	11
Clutch or Litter Size	4			eggs/clutch	F	Adult	Nevada; Sierra; CA	r	3
Clutch or Litter Size	4.23		1-6	eggs	F	Adult	PA	s	12
Clutch or Litter Size	3.66		3-4	eggs	F	Adult	Lab	t	13
Clutch or Litter Size	4.4		5 (max)	eggs/clutch	F	Adult	WY	u	14
Clutch or Litter Size	4.4			eggs/clutch	F	Adult	IA	v	15
Clutch or Litter Size	4.1			young/nest	NR	Juvenile	WI	w	16
Dietary Composition	insects (31.7%), reptiles (26.0%), birds (16.6%), mammals (25.7%)				B	Adult	Nevada; Sierra; CA	x	3
Dietary Composition	mammal (82%), insect (16%), other (2%)				B	Adult	Yolo; CA	y	17
Dietary Composition	mammal (57%), insect (42%), other (1%)				B	Adult	Yolo; CA	z	17
Dietary Composition	mammal (24%), insect (74%), other (2%)				B	Adult	Yolo; CA	aa	17
Dietary Composition	mammal (43%), insect (51%), other (6%)				B	Adult	Yolo; CA	ab	17
Dietary Composition	mammal (39%), insect (60%), other (6%)				B	Adult	Yolo; CA	ac	17
Dietary Composition	invertebrates (173.8), reptiles (23.0), birds (481.0), mammals (609.5)			g	F	Adult	San Benito; Santa Clara; CA	ad	18
Dietary Composition	invertebrates (157.5), reptiles (0), birds (272.4), mammals (221.8)			g	M	Adult	San Benito; Santa Clara; CA	ae	18
Dietary Composition	invertebrates (39.3%), herpetofauna (37.9%), mammals (22.8%)				F	NR	Humboldt; CA	af	19
Dietary Composition	invertebrates (10.5%), herpetofauna (2.4%), mammals (79.1%), birds (8.0%)				F	NR	Humboldt; CA	ag	19

Endpoint Type	Endpoint Value	Error	Range	Units	Sex	Life Stage	Location	Note	Reference
Dietary Composition	invertebrates (85.4%), vertebrates (14.6%)				NR	NR	Humboldt; CA	ah	20
Dietary Composition	insects (97%), isopod (5%), birds (27%), mammals (25%)				NR	NR	Tulare; CA	ai	21
Dietary Composition	white-footed mice (6.0%), meadow mice (78.9%), shrews (1.3%), pocket gopher (1.0%), uinta ground squirrel (0.3%), sm-med sized birds (5.7%), insects (59.9%)			%	NR	NR	WY	aj	14
Duration of Incubation or Gestation	27	0.58 SE	26-28	d	B	Embryo	Lab	ak	2
Duration of Incubation or Gestation			29-31	d	B	Embryo	Nevada; Sierra; CA	al	3
Duration of Incubation or Gestation	30.9		28-35	d	B	Embryo	PA	am	12
Duration of Incubation or Gestation	28.4		27-33	d	B	Embryo	Lab	an	13
Fledging or Weaning Rate	49%		42-57	%	B	Adult	PA	ao	22
Fledging or Weaning Rate	3.1		2.5-3.6	fledged/active nest	B	Fledgling	Lassen; CA	ap	1
Fledging or Weaning Rate	3.7		2.5-4.6	fledged/successful nest	B	Fledgling	Lassen; CA	aq	1
Fledging or Weaning Rate	5.0		3.5-5.46	number of fledglings per nest	B	Fledgling	MO	ar	11
Fledging or Weaning Rate	98			%	B	Fledgling	Nevada; Sierra; CA	as	3
Fledging or Weaning Rate	2.2			fledglings per nest	B	Fledgling	Sacramento; CA	at	23
Fledging or Weaning Rate	4.0	0.41		fledges/nest	NR	Fledgling	WA	au	24
Fledging or Weaning Rate	4.2			fledglings/pair	NR	Fledgling	WY	av	14
Fledging or Weaning Rate	88%			%	NR	Juvenile	WI	aw	16
Fledging or Weaning Rate	89%			%	NR	Juvenile	IA	ax	15
Food Ingestion Rate	0.42			kcal/g/day	M	Adult	Lab	ay	25
Food Ingestion Rate	43.6		28.0-70.2	cal/d	M	Adult	Lab	az	26
Food Ingestion Rate			18-21	g	B	NR	Lab	ba	14
Foraging Distance			<0.5-3.5	km	F	Adult	Yolo; CA	bb	27
Growth Rate	y = 7.77 + 7.44x				F	Nestling	Nevada; Sierra; CA	bc	3
Growth Rate	0.239				F	Nestling	Lab	bd	8
Growth Rate	y = 8.89 + 7.33x				M	Nestling	Nevada; Sierra; CA	be	3
Growth Rate	0.250				M	Nestling	Lab	bf	8
Hatching Success	79		70-83	%	B	Hatchling	Lassen; CA	bg	1
Hatching Success	89.3			%	B	Hatchling	Nevada; Sierra; CA	bh	3
Hatching Success	68%			%	NR	Juvenile	IA	bi	15
Hatching Success	2			%	NR	Nestling	WY	bj	14
Home Range	109.4			ha	B	Adult	Nevada; Sierra; CA	bk	3
Home Range	1.5			mi	NR	NR	IL	bl	28
Home Range	1.4			mi	NR	NR	IL	bm	28
Inhalation Rate	35.4	3.21 SD		#/min	NR	Adult	Lab	bn	29

Endpoint Type	Endpoint Value	Error	Range	Units	Sex	Life Stage	Location	Note	Reference
Longevity	12			yr	NR	Adult	Lab	bo	30
Longevity	11-07			yr-mo	NR	Adult	USA	bp	31
Longevity	118			mo	B	Both Adult and Juv.	USA	bq	32
Metabolic Rate			1.146-1.682	ml oxygen/g/hr	B	Adult	Lab	br	33
Metabolic Rate	40.8			kcal/d	NR	Adult	Lab	bs	34
Metabolic Rate	23.06	1.03 SE	21.83-25.10	kcal/d	NR	Adult	Lab	bt	35
Population Density	23			individuals per 96 km2	B	Adult	Yolo; CA	bu	27
Population Density	50			individuals in 175 km2	B	Adult	MO	bv	36
Population Density			17-27	individuals per 52 km^2	B	Adult	OH	bw	37
Population Density	0.06		0.05-0.13	pairs per km2	B	Adult	MO	bx	11
Population Density	20			individuals/ 1476 sq km	B	Adult	WA	by	24
Population Density	10			pairs/1476 sq km	B	Adult	WA	bz	24
Population Density	1			pair/1.1 mi^2	B	Adult	WY	ca	14
Population Density	115	+/- 25 95% CI		individuals/ 100 mi	B	Both Adult and Juv.	Colusa; Humboldt; Lake; Mendocino; Yolo; CA	cb	38
Population Density	34	+/- 11 95% CI		kestrels/10 0 mi	B	Both Adult and Juv.	Colusa; Humboldt; Lake; Mendocino; Yolo; CA	cc	38
Population Density	48			individuals in 175 km2	B	Both Adult and Juv.	MO	cd	36
Population Density	0.22			individuals per km2	B	Both Adult and Juv.	MO	ce	11
Population Density	0.58			birds/mi2	NR	NR	IL	cf	28
Population Density	4			individuals/ 43 sq mi	NR	NR	IL	cg	28
Surface Area	7.15 x 10E-3			m^2	NR	Adult	Lab	ch	39
Surface Area	7.15 x 10E-3			m^2	NR	Adult	Lab	ci	39
Survival/ Mortality	0.465	0.017 SD			B	Adult	CANADA; USA	cj	10
Survival/ Mortality	0.602	0.035 SD			B	Both Adult and Juv.	CA	ck	10
Survival/ Mortality	12.6			mo	B	Both Adult and Juv.		cl	32
Survival/ Mortality	57			%	B	Both Adult and Juv.	USA	cm	7
Survival/ Mortality	78			%	B	Hatchling	PA	cn	12
Territory Size	1.4			km	B	Adult	OH	co	37
Territory Size	31.6	10.7 SD	18.7-42.0	ha	F	Adult	San Benito; Santa Clara; CA	cp	18
Territory Size	13.1	2.0 SD	9.7-14.8	ha	M	Adult	San Benito; Santa Clara; CA	cq	18
Territory Size			0.16-1.93	mi^2	NR	Adult	WY	cr	14
Territory Size			0.65-2.32	mi^2	NR	Adult	MI	cs	14

Endpoint Type	Endpoint Value	Error	Range	Units	Sex	Life Stage	Location	Note	Reference
Time of Fledging or Metamorphosis	July 29		July 5 - August 25		B	Fledgling	Lassen; CA	ct	1
Time of Hatching or Parturition	June 21		June 7- July 26		B	Hatchling	Lassen; CA	cu	1
Time of Hatching or Parturition	Jun 20-Jun 22				NR	Nestling	WY	cv	14
Time of Mating/ Laying	May 22		May 6 - June 26		F	Adult	Lassen; CA	cw	1
Time of Mating/ Laying	March-May				F	Adult	Lab	cx	2
Time of Mating/ Laying	late May - June				F	Adult	Nevada; Sierra; CA	cy	3
Time of Migration or Dispersal	August (begin)				B	Both Adult and Juv.	CA	cz	40
Time of Migration or Dispersal	February (peak)				B	Both Adult and Juv.	CA	da	40
Time of Migration or Dispersal	August (begin), October (peak), November (end)				B	NR	Marin; CA	db	41
Time of Molt	May - September				B	Adult	Nevada; Sierra; CA	dc	3
Time of Molt	July-October/November				B	Adult	USA	dd	7
Time of Nesting	May 20 to Jul 20				B	Adult	WY	de	14

Notes

a	N=112; Great Basin (elev. 1260-2340 m)
b	mean nestling period; N=29 chicks; spring
c	N=NR; Sagehen Creek Field Station
d	total body fat based on Soxhlet fat extraction; N=21
e	percent body fat calculated from total body electrical conductivity; N=13; Condition=migrating; Cape May
f	mean percent body fat as measured by fat extraction from April to September; N=14; Condition=premigratory; April, July, September; Cache county
g	percent body fat calculated from total body electrical conductivity; N=12; Condition=migrating; Cape May
h	N=72; throughout USA
i	average body weight; N=26 birds
j	N=88; throughout USA
k	average body weight; N=25 birds
l	mean body weight measured over 4 years; N=111; coastal southern CA; see citation for body weights by region and season
m	mean body weight measured over 4 years; N=69; coastal southern CA; see citation for body weights by region and season
n	body weight at hatch; N=NR; Sagehen Creek Field Station
o	N=38 clutches; Great Basin (1260-2340 m)
p	N=244; unpublished data
q	mean clutch size over 3 years; N=28 pairs; Condition=Breeding; rural and urban lands
r	average clutch size; N=42; Sagehen Creek Field Station
s	N=13 clutches; spring; Berks county
t	mean clutch size in captivity; N=5; Condition=Breeding
u	N=10 nests; spring; Jackson Hole
v	mean clutch size (4 sample years); N=7-23 nests/year; Lucas and Wayne Counties (40deg57'N, 93deg18'W); All data are from artificial nest boxes.
w	mean brood size (13 sample years); N=37 successful nests; Portage County (44deg27'N, 89deg40'W)
x	percent of prey by prey weight; N=NR; Condition=breeding; Sagehen Creek Field Station; see citation for dietary composition by occurrence or cube-root of prey body weight
y	percent composition of sample pellets (by volume); N=116 pellets; Jun.- Jul.; agricultural lands; values estimated from citation figure
z	percent composition of sample pellets (by volume); N=59 pellets; Condition=breeding; Feb.-Mar.; agricultural lands; values estimated from citation figure
aa	percent composition of sample pellets (by volume); N=104 pellets; Condition=breeding; May-Jun.; agricultural lands; values estimated from citation figure
ab	percent composition of sample pellets (by volume); N=71 pellets; Condition=breeding; Mar.-Apr.; agricultural lands; values estimated from citation figure
ac	percent composition of sample pellets (by volume); N=95 pellets; Condition=breeding; Apr.-May; agricultural lands; values estimated from citation figure
ad	amount of prey taken by prey weight; N=5; winter; Hollister Basin (elev. 48-210 m); see citation for detailed dietary description
ae	amount of prey taken by prey weight; N=5; winter; Hollister Basin (elev. 48-210 m); see citation for detailed diet description
af	dietary composition (% of total biomass), 1973-1974; N=3; winter; Arcata Bottoms

ag	dietary composition (% of total biomass), 1972-1973; N=4; winter; Arcata Bottoms
ah	relative numbers of dietary items captured; N=24 birds; October-February; Arcata Bottoms; pasture
ai	percent occurrence in sample pellets; N=NR; agricultural lands
aj	percent occurrence of prey items in pellets during nesting; N=299 pellets from 8 nests; spring; Jackson Hole
ak	mean number of days between 5th egg laid and 5th egg hatched; N=3 eggs; spring
al	N=NR; Sagehen Creek Field Station
am	incubation period; N=2 clutches (8 eggs); spring; Berks county
an	mean incubation period in captivity; N=5; Condition=Breeding
ao	mean percent of successful nests per year; N=259 nesting attempts; Berks and Lehigh counties; Successful nests were defined as those which fledged at least one young.
ap	N=36 nests; Great Basin (1260-2340 m)
aq	N=30 nests; Great Basin (1260-2340 m)
ar	three year mean fledging rate; N=28 pairs; Condition=Breeding; rural and urban lands
as	of chicks that hatched; N=150; Sagehen Creek Field Station
at	fledging rate per successful nest; N=17; spring; American River; oak woodlands, grasslands, residential
au	average number of young fledged; N=4 nests; Hanford Site, Benton and Franklin Counties
av	number of fledglings produced per pair; N=10 nests; spring; Jackson Hole
aw	percent of nests that fledged at least one young; N=42 nests; Portage County (44deg27'N, 89deg40'W)
ax	mean percent of young hatched that fledged (4 sample years); N=148 hatchlings; Lucas and Wayne Counties (40deg57'N, 93deg18'W); All data are from artificial nest boxes.
ay	mean caloric consumption per g body weight per day (wet weight basis); N=2; August
az	average and range of daily caloric intake (food provided ad libidum); N=1 bird; Condition=sedentary, injured
ba	averages of food amounts eaten per day; N=3 birds; Condition=captive; spring
bb	distance foraged from nest; N=4; Condition=Breeding; February 19-July 8; agricultural lands (lat, 38 deg 32'N; long., 121 deg 47'W)
bc	growth rate from day 3-16; N=NR; Sagehen Creek Field Station; see citation for growth curve
bd	growth rate of body weight in parent-reared birds; N=8 birds; See citation for growth rate of hand-reared birds.
be	growth rate from day 3-16; N=NR; Sagehen Creek Field Station; see citation for growth curve
bf	growth rate of body weight in parent-reared birds; N=11 birds; See citation for growth rate of hand-reared birds.
bg	mean hatchability measured over 4 years; N=157 boxes; Great Basin (elev. 1260-2340 m)
bh	N=168; Sagehen Creek Field Station
bi	mean percent of eggs hatched of total eggs laid (4 sample years); N=217 eggs; Lucas and Wayne Counties (40deg57'N, 93deg18'W); All data are from artificial nest boxes.
bj	percent of eggs that failed to hatch; N=10 nests; spring; Jackson Hole
bk	average home range - breeding; N=32; Sagehen Creek Field Station
bl	mean maximum diameter of winter home ranges; N=3 birds; winter; agricultural lands; based on distances between extreme observation points for individual kestrels
bm	mean maximum diameter of breeding home ranges; N=4 birds; spring; agricultural lands; based on distances between extreme observation points for individual kestrels
bn	mean resting respiratory rate; N=4; Condition=crippled, non-releasable; corresponding mean body weight was 110 g
bo	N=1; captive individual
bp	from USFWS Bird Banding Laboratory data; N=1832 band recoveries
bq	longest survival of a banded individual; N=1,017 records of mortality
br	combined day and night oxygen consumption over one 24 hr period; N=3 birds
bs	existence metabolism as measured by the difference between food energy and energy in egesta of birds maintained at constant body mass for periods of 3 or more days; N=NR; winter
bt	daily energy metabolism based on heart rate (30 C) and a linear regression equation for heart rate and volume of oxygen consumed; N=1; see citation for other metabolic estimates
bu	N=23; Condition=Breeding; February 19-July 8; agricultural lands (lat, 38 deg 32'N; long., 121 deg 47'W)
bv	N= 1 study area; Condition=Breeding; Mar.-Aug.; agricultural lands, woodlots, meadows
bw	N=NR; Condition=wintering; winter; southcentral area, agricultural lands; see citation for figure showing seasonal population size
bx	mean pair density in study area (194 km2); N= 5 years; Condition=Breeding; rural and urban lands
by	number of individual kestrels counted annually on study site; N=4 years; Hanford Site, Benton and Franklin Counties
bz	number of nesting pairs counted annually on study site; N=4 years; Hanford Site, Benton and Franklin Counties
ca	density of nesting pairs; N=10 nests; spring; Jackson Hole
cb	average density; N=205 obs.; winter; agricultural lands; males predominant in areas with trees, females predominant in areas with few trees
cc	average density; N=135 obs.; winter; coastal and coast range areas; males predominant in areas with trees, females predominant in areas with few trees

cd	N= 1 study area; Sep.-Feb.; agricultural lands, woodlots, meadows
ce	mean density in study area; N=5 years; winter; rural and urban lands
cf	breeding population density; N=25 birds; January-June; agricultural lands
cg	wintering population size; N=NR; December-January; agricultural lands
ch	dorsal surface area; N=NR
ci	ventral surface area; N=NR
cj	mortality rate of banded individuals, 1946-65; N=6,544; throughout USA and Canada
ck	mortality rate estimate for banded individuals; N=118; throughout USA and Canada; kestrels banded as nestlings from 1925 to 1945
cl	average length of survival of banded individuals; N=1,017; throughout USA
cm	average annual mortality of banded individuals (over 6 years); N=NR; throughout USA; corresponds to life expectancy of 15 months for banded individuals
cn	hatching success; N=55 eggs (14 clutches); spring; Berks county
co	average diameter of territories; N=16; Condition=wintering; winter; southcentral area, agricultural lands
cp	N=5; winter; Hollister Basin (elev. 48-210 m)
cq	N=5; winter; Hollister Basin (elev. 48-210 m)
cr	observed range of movement during nesting, based on observations of individual or pair movements; N=11 birds; spring; Jackson Hole
cs	observed range of movement, based on observations of individuals; N=8 birds; winter; Superior Township
ct	median fledging date; N=27 pairs; Great Basin (elev. 1260-2340 m)
cu	median hatching date; N=27 pairs; Great Basin (elev. 1260-2340 m)
cv	dates of earliest and latest hatching; N=11 nests; spring; Jackson Hole
cw	median date of laying; N=27 pairs; Great Basin (elev. 1260-2340 m)
cx	period of laying; N=NR; Condition=breeding; spring; see citation for regional differences in date of laying initiation
cy	entire laying period; N=NR; Sagehen Creek Field Station
cz	period of fall migration of individuals fledged in northern CA, or at high elevations; N=NR; throughout state
da	period of spring migration of individuals fledged in northern CA, or at high elevations; N=NR; throughout state
db	time period of fall migration; N=276; fall; Pt. Diablo, Marin Headlands; see citation for monthly count data
dc	N=NR; Sagehen Creek Field Station
dd	period of molt; N=NR; throughout USA
de	period from earliest egg laying date to date of latest brood departure; N=11 nests; spring; Jackson Hole

References

1 Bloom, Peter H. and Stephen J. Hawks. 1983. Nest box use and reproductive biology of the American kestrel in Lassen County, California. J. Raptor Res. 17(1):9-14.

2 Porter, Richard D. and Stanley N. Wiemeyer. 1972. Reproductive patterns in captive American kestrels (sparrow hawks). Condor. 74:46-53.

3 Balgooyen, Thomas G. 1976. Behavior and ecology of the American Kestrel in the Sierra Nevada of California. Univ. Calif. Publ. Zool. 103:.

4 Harden, Shari M. 1993. Fat content of American kestrels and sharp-shinned hawks estimated by total body electrical conductivity. Master's thesis. Logan, UT: Utah State University, Logan. 42 p.

5 Gessaman, J.A. and S.M. Harden. 1995. Fat content of American kestrels and sharp-shinned hawks estimated by total body electrical conductivity. J. Raptor Res. 29(1):56-57.

6 Gessaman, James A. 1979. Premigratory fat in the American kestrel. Wilson Bull. 91(4):625-626.

7 Roest, A.I. 1957. Notes on the American sparrow hawk. Auk. 74(1):1-19.

8 Bird, David M. and Robert G. Clark. 1983. Growth of body components in parent- and hand-reared captive kestrels. J. Raptor Res. 17(3):77-84.

9 Bloom, Peter H. 1973. Seasonal variation in body weight of sparrow hawks in California. West. Bird Bander. 48(2):17-19.

10 Henny, Charles J. 1972. An analysis of the population dynamics of selected avian species with special reference to changes during the modern pesticide era. Washington, D. C.: United States Department of the Interior, Fish and Wildlife Service, Wildlife Research Report No. 1. 23-28 p.

11 Toland, Brian R. and William H. Elder. 1987. Influence of nest-box placement and density on abundance and productivity of American kestrels in central Missouri. Wilson Bull. 99:712-717.

12 Heintzelman, Donald S. and Alexander C. Nagy. 1968. Clutch sizes, hatchability rates, and sex ratios of sparrow hawks in eastern Pennsylvania. Wilson Bull. 80(3):306-311.

13 Willoughby, Ernest J. and Tom J. Cade. Breeding behavior of the American kestrel (sparrow hawk). Living Bird. 3:75-96.

14 Craighead, John J. and Frank C. Craighead, Jr. 1969. Hawks, Owls and Wildlife. New York, N.Y.: Dover Publications, Inc. 443 p.

15 Craft, Randall A. and Karen P. Craft. 1996. Use of free ranging American kestrels and nest boxes for contaminant risk assessment sampling: a field application. J. Raptor Res. 30(4):207-212.

16 Jacobs, Eugene A. 1995. American kestrel reproduction and dispersal in central Wisconsin. J. Raptor Res. 29(2):135-137.

17 Rudolph, Seri Gale. 1980. The hunting behavior of American kestrels: Applications of foraging theory. Master's thesis. Davis, CA: University of California at Davis. 64 p.

18 Meyer, Ruthe Lashe and Thomas G. Balgooyen. 1987. A study and implications of habitat separation by sex of wintering American kestrels (Falco sparverius). J. Raptor Res. 6:107-123.

19 Collopy, Michael W. and James R. Koplin. 1983. Diet, capture success, and mode of hunting by female American kestrels in winter. Condor. 85:369-371.

20 Collopy, Michael W. 1973. Predatory efficiency of American kestrels wintering in northwestern California. J. Raptor Res. 7(2):25-31.

21 Hawkins, Cole Carlson. 1991. Food habits and abundance of raptors in an agricultural area of Tulare County, California. Master's thesis. Fresno, CA: California State University, Fresno. 102 p.

22 Rohrbaugh, Ronald W., Jr., and Richard H. Yahner. 1997. Effects of macrohabitat and microhabitat on nest-box use and nesting success of American kestrels. Wilson Bull. 109(3):410-423.

23 Vincenty, Joseph A., III. 1974. A study of factors affecting nesting raptor populations in urban ares, Sacramento County, California - 1974. Sacramento, CA: California Department of Fish and Game, Wildlife Management Branch Administrative Report No. 74-5. 1-21 p.

24 Fitzner, R.E. 1980. Impacts of a nuclear energy facility on raptorial birds, In: Richard P. Howard and James F. Grove, eds. Workshop on Raptors and Energy Developments: Proceedings of a Workshop; January 25-26, 1980; Boise, Idaho. Boise, ID: U.S. Fish and Wildlife Service. p 9-33.

25 Barrett, Gary W. and Mackey, Carl V. 1975. Prey selection and caloric ingestion rate of captive American kestrels. Wilson Bull. 87(4):514-519.

26 Wing, Leonard and Anne H. Wing. 1939. Food consumption of a sparrow hawk. Condor. 41:168-170.

27 Rudolph, Seri G. 1982. Foraging strategies of American kestrels during breeding. Ecology. 63:1268-1276.

28 Enderson, James Harris. 1960. A population study of the sparrow hawk in east-central Illinois. Wilson Bull. 72(3):222-231.

29 Daniels, Kathleen and G.E. Duke. 1980. Factors influencing respiratory rates in four species of raptors. Comp. Biochem. Physiol., A , Comp. Physiol. 66:703-706.

30 Kuyt, E. 1972. Longevity in a captive sparrow hawk. Blue Jay. 30:197.

31 Clapp, Roger B., M. Kathleen Klimkiewicz and John H. Kennard. 1982. Longevity records of North American birds: Gaviidae through Alcidae. J. Field Ornithol. 53(2):81-124.

32 Keran, Doug. 1981. The incidence of man-caused and natural mortalities to raptors. J. Raptor Res. 15(4):108-112.

33 Gatehouse, S.N. and B.J. Markham. 1970. Respiratory metabolism of three species of raptors. Auk. 87:738-741.

34 Koplin, James R., Michael W. Collopy, Albert R. Bammann and Howard Levenson. 1980. Energetics of two wintering raptors. Auk. 97:795-806.

35 Gessaman, James A. 1980. An evaluation of heart rate as an indirect measure of daily energy metabolism of the American kestrel. Comp. Biochem. Physiol., A , Comp. Physiol. 65:273-289.

36 Toland, Brian R. 1987. The effect of vegetative cover on foraging strategies, hunting success and nesting distribution of American kestrels in central Missouri. J. Raptor Res. 21:14-20.

37 Mills, G. Scott. 1975. A winter population study of the American kestrel in central Ohio. Wilson Bull. 87:241-247.

38 Koplin, James R. 1973. Differential habitat use by sexes of American kestrels wintering in northern California. J. Raptor Res. 7(2):39-42.

39 Hayes, Stephen R. and James A. Gessaman. 1982. Prediction of raptor resting metabolism: comparison of measured values with statistical and biophysical estimates. J. Therm. Biol. 7:.

40 Bloom, Peter H. 1985. Raptor movements in California, In: Michael Harwood, eds. Hawk Migration Association of North America. Proceedings of Hawk Migration Conference IV. Medford, MA: p 313-323.

41 Binford, Laurence C. 1979. Fall migration of diurnal raptors at Pt. Diablo, California. West. Birds. 10(1):1-16.